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Atty. Docket No. PIA31075/DBE/US  
Serial No: 10/750,246

Amendments to the Figures

Figures 1A-1D are amended by replacing the accurate label "(BACKGROUND)" (see p. 1, l. 6 of the specification) with the inaccurate label "(PRIOR ART)", as required in the Office Action dated June 7, 2006. The application as originally filed contained no admission that FIGS. 1A-1D are prior art, and the Examiner cites no such admission, either. However, in the interest of advancing prosecution, Applicants conditionally amend Figures 1A-1D to obviate the Examiner's requirement that FIGS. 1A-1D be labeled as prior art, even though no such admission as ever been made by Applicants. Applicants hereby reserve their right to amend the drawings to remove the incorrect "PRIOR ART" label, should it be deemed necessary or desirable to do so.

Two (2) Replacement Sheets (as required by 37 C.F.R. 1.121(d)) are attached to this Amendment.

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Remarks

The present invention relates to a method of removing polymer generated in a semiconductor manufacturing process. The semiconductor manufacturing process may include sequentially depositing a lower metal layer, an insulating layer and an upper metal layer on a semiconductor substrate, forming a photoresist pattern on the upper metal layer, and etching the upper metal layer and the insulating layer using the photoresist pattern as a mask. The polymer may be generated during the etching step of the semiconductor manufacturing process. The method of removing polymer (as set forth in Claim 1 above) generally comprises:

- (a) removing the photoresist pattern using an  $O_2/N_2$  plasma; and
- (b) removing the polymer existing on the lower metal layer using an  $H_2O/CF_4$  plasma; and
- (c) using a plasma from a gas consisting essentially of  $O_2$ , removing residues of the remaining photoresist pattern.

Alternatively, the present invention relates to a method of removing polymer (as set forth in Claim 10 above) that generally comprises:

- (i) removing the first photoresist pattern by ashing with a first plasma from a first gas mixture consisting essentially of  $O_2$  and  $N_2$ ;
- (ii) removing the polymer on the lower metal layer by ashing with a second plasma from a second gas mixture consisting essentially of  $H_2O$  and  $CF_4$ ; and
- (iii) removing remaining residues of the first photoresist pattern with a third plasma from a gas consisting essentially of  $O_2$ .

The reference cited against the claims (Jung, U.S. Pat. Appl. Publ. No. 2003/0114010 [hereinafter "Jung"]) is believed to neither disclose nor suggest removing a photoresist pattern by using a plasma of  $O_2$  and  $N_2$ , removing a polymer from a lower metal layer by using a plasma of  $H_2O$  and  $CF_4$ , or removing residues of the remaining photoresist pattern using a plasma from a gas consisting essentially of  $O_2$  (see Claims 1 and 8 above). Furthermore, the cited reference neither discloses nor suggests removing a photoresist pattern by ashing with a first plasma from a first gas mixture consisting essentially of  $O_2$  and  $N_2$ , removing a polymer on a lower metal layer

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by ashing with a second plasma from a second gas mixture consisting essentially of H<sub>2</sub>O and CF<sub>4</sub>, and removing residues of the remaining photoresist pattern with a third plasma from a gas consisting essentially of O<sub>2</sub> (see Claim 10 above). Consequently, the present claims are patentable over the cited reference.

The Rejection of Claims 1-19 under 35 U.S.C. § 103(a)

The rejection of Claims 1-19 under 35 U.S.C. § 103(a) as being unpatentable over the "Background" disclosure in the present application (hereinafter, "Applicant's discussion of the background") in view of Jung is respectfully traversed.

The evidence relied upon in the Office Action for concluding that Applicant's application contains admitted prior art identifies no statement "identifying the work of another as 'prior art'." (See M.P.E.P. § 2129). The Examiner has not taken official notice that Applicant's discussion of the background are commonly known in the art, nor has the Examiner relied on a self-executed Affidavit attesting to his personal knowledge of facts establishing such technology as prior art available under 35 U.S.C. §

In the previous amendment filed March 3, 2006, Applicants traversed all effective assertions of official notice that Applicant's discussion of the background is admitted prior art or is otherwise available as prior art. Consequently, to properly maintain this ground of rejection, the Office Action dated June 7, 2006 should have provided documentary evidence establishing FIGS. 1A-1D of the present application as the work of another, available under one or more sections of 35 U.S.C. § 102.

Nonetheless, Applicant's discussion of the background discloses technology generally considered to be conventional. As such, Applicant does not intend to claim subject matter disclosed in the "Background" section of the present application. The present invention represents an improvement over that subject matter.

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That being said, and assuming for the sake of argument that the technology shown in the Background section of Applicant's specification is available as prior art against the present claims, the background discussion in the present application neither discloses nor suggests removing a photoresist pattern using an O<sub>2</sub> / N<sub>2</sub> plasma, removing a polymer from a lower metal layer using an H<sub>2</sub>O / CF<sub>4</sub> plasma, or removing residues of the remaining photoresist pattern using a plasma from a gas consisting essentially of O<sub>2</sub>, as recited in Claims 1 and 8 (and claims dependent therefrom). Furthermore, Applicant's discussion of the background neither discloses nor suggests removing a photoresist pattern by ashing with a first plasma from a first gas mixture consisting essentially of O<sub>2</sub> and N<sub>2</sub>, removing a polymer on a lower metal layer by ashing with a second plasma from a second gas mixture consisting essentially of H<sub>2</sub>O and CF<sub>4</sub>, and removing residues of the remaining photoresist pattern with a third plasma from a gas consisting essentially of O<sub>2</sub> (see new Claim 10).

Jung discloses a method for fabricating a semiconductor device which includes methods of photoresist stripping and cleaning, which shows a favorable contact resistance by performing dry cleaning while stripping a photoresist and effectively removing the residue formed on contact holes (see paragraph [0013]). In a first step, the polymers on the sidewalls are removed in a mixed gas atmosphere of N<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>O, CF<sub>4</sub> and O<sub>2</sub> by using RF power and microwave (see paragraphs [0019]-[0020] and [0047]). In a second step, Jung removes a photoresist in a mixed gas atmosphere of N<sub>2</sub>, CF<sub>4</sub> and O<sub>2</sub> (see paragraphs [0021] and [0048]), and in a third step, the residue on the bottom of via holes is removed in a mixed gas atmosphere of N<sub>2</sub>, H<sub>2</sub>O, CF<sub>4</sub> and O<sub>2</sub> by using a microwave (see paragraphs [0022] and [0049]).

In the methods of claims 1, 8 and 10, a polymer on a lower metal layer is removed with an H<sub>2</sub>O / CF<sub>4</sub> plasma, and residues of the photoresist pattern remaining thereafter are removed with a plasma from a gas consisting essentially of O<sub>2</sub>. This is beneficial because the residues of the photoresist pattern are believed to not be easily hardened when using O<sub>2</sub> gas in the plasma, without H<sub>2</sub>O. Generally, it is believed that the residues of the photoresist pattern may be relatively easily hardened when such residues contact or are exposed to a plasma from H<sub>2</sub>O gas. Jung discloses that polymers on the sidewalls are removed in the atmosphere of a mixed gas of

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N<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>O, CF<sub>4</sub>, and O<sub>2</sub>, and residue on the bottom of via holes is removed in a mixed gas atmosphere of N<sub>2</sub>, H<sub>2</sub>O, CF<sub>4</sub> and O<sub>2</sub>. However, using such mixed gases is believed to cause hardening of the polymers, because of the presence of H<sub>2</sub>O gas in the mixed gases.

Thus, Jung is saliently deficient with regard to the present Claims 1, 8 and 10. Furthermore, because Jung discloses use of a plasma formed from gases in addition to O<sub>2</sub> to remove polymers on the sidewalls and residue on the bottom of via holes, Jung fails to cure the deficiencies of Applicant's discussion of the background with regard to the present Claims 1, 8 and 10.

As a result, the combination of Applicant's discussion of the background and Jung fails to disclose or suggest removing residues of the remaining photoresist pattern using a plasma from a gas consisting essentially of O<sub>2</sub>, as recited in Claims 1 and 8 above, or removing a photoresist pattern by ashing with a first plasma from a first gas mixture consisting essentially of O<sub>2</sub> and N<sub>2</sub>, removing a polymer on a lower metal layer by ashing with a second plasma from a second gas mixture consisting essentially of H<sub>2</sub>O and CF<sub>4</sub>, and removing residues of the remaining photoresist pattern using a plasma from a gas consisting essentially of O<sub>2</sub>, as recited in Claim 10 above. Consequently, this ground of rejection is unsustainable, and should be withdrawn.

#### The Objection to the Drawings

The objection to the drawings has been overcome by appropriate amendment.

#### Conclusions

In view of the above amendments and remarks, all bases for objection and rejection are overcome, and the application is in condition for allowance. Early notice to that effect is earnestly requested.

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If it is deemed helpful or beneficial to the efficient prosecution of the present application, the Examiner is invited to contact Applicant's undersigned representative by telephone.

Respectfully submitted,



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